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Energy Assessment of Smithtown, New York

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Abstract

Energy management and carbon mitigation plans, often created to address global issues, must be implemented locally. Each specific area has its own needs and problems. For this study, we used publicly available data to create an energy assessment for the Town of Smithtown, a municipality of 116,000 people on the north shore of Long Island (New York). We found that motor vehicles consume the largest amount of energy, followed by space heating for both residential and commercial-industrial purposes. Local policies probably can only modestly affect transportation energy use, although federal policies may have significant effects over the next several decades. A local renovation financing program holds great promise to improve residential heating energy usage, and could greatly reduce energy consumption if it is expanded to cover the commercial sector. Current Town programs have begun to address immediate needs, although programs will require revision to achieve major reductions in energy use.

Key words: energy inventory, energy assessment, local, planning, mitigation, public data

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TEXT:

There have been notable increases in greenhouse gas (GHG) concentrations since the pre-industrial era (circa 1750) (27), leading to increasing global temperatures and other climatic effects due to a greater greenhouse effect (5). Climate experts are becoming more pessimistic regarding the magnitude of potential mitigation (28), especially in light of the ineffectiveness of initiatives over the past several decades to reduce carbon emissions (16). However, if climate change is to be successfully addressed in the near future, it would seem to require the selection of strategies which employ available technologies to achieve well-defined goals (14). However, grand designs need to be applied under local conditions. It has been recognized that implementation of energy conservation and carbon emission prevention actions need to be crafted for particular combinations of technology availability and economic capability (19)). Energy use also varies significantly from one part of the country to another (9). Furthermore, it is also recognized that many of these plans and implementation programs need to be developed at the local level, where planning and land use decisions, efficiency initiatives, and renewable energy projects can be fostered (20).

Many agencies and planning groups see a need to inventory energy use (and/or carbon emissions) as a guide to identify areas that need the greatest attention, where the greatest changes can be made, or where the most cost-effective activities can be implemented (20, 12). Therefore, we prepared this energy assessment for the Town of Smithtown (Long Island, NY), as a first step in creating a tailored, site-specific energy reduction and GHG control program. Our intention was to use readily available public information and avoid creating new data sets. Thus, we think that our approach can be easily used by other planners as a template for their own local energy

assessments, to then craft specific planning initiatives to produce the greatest effect on local energy use (and associated GHG releases).

Setting

The Town of Smithtown is located on the north shore of Long Island in western Suffolk County, approximately 50 miles east of New York City (Figure 1). The unincorporated areas of the Town (the subject of this paper) cover approximately 45 square miles, and had a 2009 population of 115,294 (7). The Town is almost entirely composed of residential, single-family housing, on lots ranging from 0.25-2 acres, although there are some multi-family residential developments as well. There are three central (downtown) business districts in the Town, as well as numerous strip commercial and industrial corridors and three large shopping centers. An extensive parkland complex is associated with the Nissequogue River, in the center to northwest parts of the Town. Almost the entirety of the Hauppauge Industrial Park, the largest planned industrial park in the country when it was conceived in 1953 (3, 4) and still the largest in the northeast US, is located in the southwest portion of the Town. All else is essentially residential development (Figure 2).

Reducing fossil fuel consumption and energy consumption in general is already part of the local municipal agenda. The Town has completed energy assessments and installed energy saving technologies such as motion detecting light sensors and compact fluorescent lights in many municipal buildings. Beginning in 2006, the Town's solid waste district contracts have required contractors to use compressed natural gas (CNG) garbage collection vehicles (1), and in 2010 the Town constructed and opened a CNG fueling station at its municipal waste management facility. The Town no longer purchases conventionally-fueled passenger vehicles, only those that are gasoline-electric hybrids or use flex fuel or CNG.

While these efforts have focused on reducing municipal energy consumption, the Town has begun to take steps to improve energy efficiency and reduce fossil fuel energy consumption throughout the entire Town. In 2008, the Town adopted an amendment to its Building Code (Code of the Town of Smithtown §112-1.2 ENERGY STAR program) requiring all new single-family, two-family, and some multi-family dwellings be constructed to comply with the Long Island Power Authority (LIPA) New York ENERGY STAR Labeled Homes Program requirements. In 2010, a block grant from the US Department of Energy was used to replace approximately 25% of the standard streetlights with light emitting diodes (LEDs), and the Town plans to replace the other 75% over the next few years. In December 2009, the Town helped form the Long Island Green Homes and Buildings Consortium (with nine other local governments, a local college, and a non-profit organization) to develop financing options for making energy efficiency retrofits to single-family dwellings, and is currently working with NYSERDA to market and implement its Green Jobs Green New York program in Smithtown.

Methodology

Information availability made collecting data by ZIP codes the simplest way to gather and organize much of the information. There are seven ZIP codes in the unincorporated portion of Smithtown (Table 1, Figure 3); one of the seven, Fort Salonga, has approximately 50% of its area but less than 50% of its population in the Town. Unincorporated Smithtown is the predominant element in the area and population of all other shared ZIP codes. Therefore, we defined "Smithtown" for the purposes of this paper to be the six ZIP Codes identified in Table 1. Thus, the study area is slightly different from the actual unincorporated areas of the Town.

The study examines energy consumption in the three net consumption sectors: residential, commercial and industrial, and transportation. The energy analysis for the residential sector was

completed by collecting the annual electricity, natural gas, and heating oil consumption for the single and multi-family residences in the Town from local utilities, with the exception of heating oil consumption, which was estimated based on interviews with the Oil Heat Institute of Long Island, an organization that represents the oil heating industry on Long Island and oil customers. The analysis for the commercial and industrial sector was conducted by collecting the same consumption data for all commercial and industrial businesses as well as municipal operations (e.g. government buildings, schools, libraries, etc.) in the Town. The data were collected by accounts rather than for buildings, and as a result, the study was limited to assessing the energy consumed by the sector as a whole, and not per building or per square foot. The energy analysis for the transportation sector was completed using sales records from the New York State Department of Taxation and Finance and vehicles registration data from the New York State Department of Motor Vehicles to estimate the total amount of gasoline, diesel, and alternative fuels that were used by vehicles registered in the Town. The study also included electricity consumption by street lights in this sector.

To standardize data sets, energy consumption has been recorded in trillions of British thermal units (TBtu), where 1 Btu is the quantity of heat necessary to raise the temperature of 1 pound of water one degree Fahrenheit. Conversions used in the course of data collection are listed in Table 2.

Data were collected by Internet search and agency reviews, with the exception of interviews to obtain heating oil usage, and material gathered at a presentation for the Hauppauge Industrial Association (the trade group associated with the Hauppauge Industrial Park). We also had to file one Freedom of Information Law request (for motor vehicle records from the New York Department of Motor Vehicles).

Results

Residential Energy Consumption

There were 43,764 dwelling units in Smithtown in 2000, including about 36,761 (84%) single-family detached houses, 3,328 (8%) single-family attached houses, and 693 (2%) dwelling units in multi-family buildings (21), and US Census Bureau estimates that the number of dwelling units in the Town of Smithtown grew by about 1% from 2000-2008 (23), implying there were 44,307 dwelling units in Smithtown in 2008.

Natural Gas Use

In 2008, 22,205,278 therms (2.22 TBtu) of natural gas were delivered to 20,818 residential accounts in Smithtown by all suppliers (10). Accounts have been classified by primary use of the gas (Table 3). Natural gas distributed to "hot water accounts" may also used for cooking and drying, and some space heating accounts may also use gas for hot water and cooking and drying as well. However, assuming every hot water account uses gas for cooking/drying, and every space heating account uses gas for hot water and cooking/drying, then space heating consumes at least 62% of all natural gas delivered to residential accounts.
In 2000, approximately 37% of occupied dwelling units were heated with natural gas, ranging from 18% to 64% in different ZIP Codes (22) (Table 4).

Oil Use

There is no single or primary oil distributor on Long Island; *Citidexli* (an online phone book) listed 55 home heating oil providers for Smithtown. Contacting all providers was impractical, and thought unlikely to generate useful information, as it is not clear heating oil providers could (or would) provide information regarding accounts serviced in Smithtown. This meant Smithtown-specific data were not easily accessible. Heating oil is tax exempt, unlike oil

for transportation (such as gasoline and diesel fuel), so there were no State sales tax records to quantify local or even State sales. Oil use in both the residential and commercial sector was therefore extrapolated from information drawn from the US Census Bureau, the New York State Energy and Research Development Authority (NYSERDA), the US Department of Energy, and the Oil Heat Institute of Long Island.

Specific consumption of heating oil is a function of Smithtown-variable factors such as home size, household income, and general building design, and also climate and other parameters that are constant for the Town (18). We assumed that oil consumption in Smithtown was proportional to the share of dwelling units in Smithtown compared to suburban Long Island as a whole (the percent of dwellings heated with oil in suburban Long Island was 59%, and 55% in Smithtown). Smithtown has 4.7% of suburban Long Island housing units (21), implying the Town's share of residential heating oil use (482M gallons in 2009) was 22.5M gallons (3.13 TBtu). Another estimation was made, based on the broad description that, according to the Oil Heat Institute of Long Island, the average Long Island home using oil consumes 900 gallons per year. In 2000, 23,734 dwelling units (55%) in Smithtown were heated with oil (varying from 31% to 77% across ZIP Codes) (22) (Table 5). This second method suggests Town oil consumption is approximately 21.4 M gallons of oil, in line with the first approximation. Some oil is used for water heating rather than space heating; the amount used for space heating has been estimated to be 74% to 80%) (K. Rooney, Oil Heat Institute, personal communications, 2010) (13). Using the estimate of 22.5M gallons of oil consumption per year, 15.5 – 17 million gallons of oil (2.16 – 2.37 TBtu) were used for space heating and approximately 5.4 – 6.9 million gallons of oil (0.75 – 0.96 TBtu) for hot water. It is possible that houses heat with oil but use natural gas for water heating; however, houses built on Long Island in the 1960s-1970s, the

predominant stock in Smithtown, are said unlikely to use so split its energy use (K. Rooney, Oil Heat Institute, personal communications, 2010), an observation seemingly confirmed by the small number (723) of "hot water" accounts listed with National Grid (10) (see Table 4).

Electricity Use

Residential electricity sales in 2008, including the ZIP Code excluded from our definition of the Town, were 439 million KWh (6). Since that ZIP Code has approximately 15% of the population (and dwelling units) in the Town, electricity use for residences in Smithtown was estimated for the purposes of this study as 373 million kWh (1.27 TBtu). Average consumption in the Town was 10,265 kWh per dwelling unit, 8% more than the Long Island-wide average (9,548 kWh) computed by the local power authority (LIPA). There is no specific information regarding local consumption patterns of electricity within dwellings. Data based on US averages suggest appliances account for about 56% of electricity consumption (13.7% for refrigerators and 42.3% for other appliances), air conditioning and space heating amount to 26%, and lighting and hot water are 9% each (Figure 4) (26).

Use of energy in the residential sector is summarized in Table 6.

Commercial and Industrial Energy Consumption

Natural Gas

Deliveries of natural gas in 2008 to commercial accounts in Smithtown were 22,890,131 therms (2.29 TBtu). About 80% was used by 3,377 commercial and industrial facilities, which had an average consumption rate <10,000 therms per facility. The remaining 20% of gas was distributed to 64 large facilities which consume >50,000 therms per facility. These large facilities have dual fuel capabilities and switch to an alternate fuel (usually oil) when temperatures <15°F (10) (Table 7). The Hauppauge Industrial Park, which accounts for 388 (19%) of the 1,524

commercially or industrially developed parcels in the Town of Smithtown, consumed 8.3M therms (0.83 TBtu) of natural gas in 2008, >36% of all the natural gas consumed in Smithtown (D. Winchester, Board of Directors, Hauppauge Industrial Association, personal communication, 2010).

Oil

Because of the multitude of oil providers within the Town, oil consumption was extrapolated from suburban Long Island-wide consumption data. Approximately 580M gallons of heating oil were sold to non-residential users, estimated to be 95% for space heating (K. Rooney, Oil Heat Institute, personal communications, 2010). We assumed commercial and industrial development in Smithtown is proportionate to Long Island-wide as a whole; in 1981, the last Long Island-wide land use assessment found4.7% of the commercially and industrially developed acreage (including institutional, recreational and park classifications) was in the Town of Smithtown (8), which is the same percentage of housing units currently located in the Town. Therefore, we assumed the Town has 4.7% of all commercial and industrial development for Long Island, implying oil consumption of 27M gallons (3.75 TBtu) in 2008.

Electricity

Commercial and industrial electricity sales in 2008 to accounts in the Town of Smithtown were 594 million KWh (6). This value includes the ZIP Code excluded from our Town definition, which encompasses 15% of the Town population. However, no-residential land use in the ZIP Code is limited to a moderate sized shopping center, several farms, a nursery, and several gas stations, all of which are defined as "small accounts" as natural gas users. Therefore, to address the excluded ZIP Code, we decreased the Town-wide electricity use by only 5%, making our estimate of commercial and industrial electricity use 564 million kWh (1.92 TBtu).

LIPA does not distinguish end-uses of its electricity. However, national estimates find that, for commercial users, lighting is the greatest single use of electricity (37%); cooling, ventilation, and refrigeration also amount to 37% of electricity use. Office equipment (including computers) account for 7% (Figure 5), in sharp contrast to the high proportion of electricity use in residences associated with appliances (56%) (26).

Use of energy in the commercial and industrial sector is summarized in Table 8.

Energy Consumption for Transportation

The variety of transportation modes and many sources of fuel make energy consumption in the transportation sector difficult to quantify accurately. Highway vehicles use gasoline, diesel fuel, ethanol, biodiesel, liquefied natural gas, compressed natural gas (CNG), and electricity (solar and battery powered). Trains use electricity and diesel fuel. Boats use diesel fuel, gasoline, and wind (although boat fuel use was not considered here). Airplanes use various aviation fuels, including jet fuel. We simplified our transportation analysis by restricting it to highway vehicle fuel consumption. Smithtown contains no airports, has no ferry service, and has less than one train per hour travelling through Town. We did consider street lighting in this category, however, as that is a governmentally controlled consumption.

Highway vehicles

Two approaches were taken to determine the total amount of fuel consumed by highway vehicles. One was based on sales tax data collected by the New York State Department of Taxation and Finance, which can used to back-calculate fuel sales. The second was to determine fleet fuel efficiency and estimate fuel consumption from reports of vehicle mileage.

The New York State Department of Taxation and Finance annually computes motor fuel sales, which NYSERDA then derives into sales for each county. Approximately 78% of the

motor fuel sold in New York State is gasoline, 15% is diesel fuel, and approximately 6% is fuel that is tax exempt or subject to a tax refund (24). In 2008, 677,921 thousand gallons of gasoline were sold in Suffolk County in 2008 (13), which, if the State-wide proportion applies, implies 130,369 thousand gallons of diesel were sold. If untaxed sales were distributed as the taxed sales were, this would further imply there were approximately 711 million gallons of gasoline and 137 million gallons of diesel dispensed in Suffolk County. We assumed use would be proportionate to population, so that vehicle fuel use in the Town of Smithtown would be 11.3% of the total for the County: 80.3 million gallons of gasoline (9.98 TBtu) and 15.5 million gallons of diesel (2.15 TBtu).

Alternately, 106,417 highway vehicles were registered in Smithown in 2008 (adjusted on a per capita basis for the excluded ZIP Code). Approximately 10% of the vehicles did not list a fuel use; of the remainder, 94.5% were gasoline fueled (only), 2.8% were diesel, 2.6% were flex fuel or hybrids, and <0.1% were CNG, electric, or gas conversion. Passenger cars accounted for 91% of registered vehicles, 2% were personal motorcycles, and approximately 5% were commercial vehicles (11). The average fuel efficiency of a personal passenger vehicle in 2007 was 22.5 miles per gallon (mpg), and for a personal motorcycle it was 56.2 mpg. The average car was driven 12,300 miles, and the average motorcycle 1,900 miles (25).

There were also 5,611 commercial vehicles and 27 ambulances registered in the Town of Smithtown in 2008 (11). Fuel consumption of commercial vehicles varies greatly depending on the type of vehicle (passenger car, bus, tractor-trailer, etc.), ranging between 4-12 mpg. The annual mileage driven ranges from 25,000 miles (school buses) to more than 200,000 miles (some tractor trailers) (2). Thus, this method estimates gasoline use of 66,000 thousand gallons (8.21 TBtu) by personal highway vehicles (66,000 thousand gallons by personal passenger

vehicles and 105 thousand gallons by personal motorcycles) and between 16,000-257,000 thousand gallons of fuel use by commercial vehicles (assumed to all be diesel fuel) (a range of 2.2-35.7 TBtu). Based on tax records that indicate approximately 15,000 thousand gallons of diesel were sold in Smithtown in 2008 (13), the value for commercial vehicle consumption is likely to be on the lower part of the range. We therefore selected 20,000 thousand gallons as a reasonable approximation for Smithtown (2.77 TBtu).

Electricity Usage

There were only 10 electric vehicles in the Town of Smithtown in 2009, and their consumption of energy was not meaningful. Streetlights, however, are powered by electricity, and they consumed 7,453,200 kWh (0.03 TBtu) of electricity in 2008 (6).

Transportation sector energy uses are summarized in Table 9. For the purposes of the analysis, we chose the sales tax method over the vehicle type-mileage method, although there really was no reason to prefer one to the other; our choice was approximately 10% greater in value, and distributed slightly differently.

Total energy use in the Town of Smithtown can be estimated as in Table 10.

Discussion

Analysis of Methodology

There are a number of limitations associated with this methodology. First, we only analyzed net energy consumption, and did not include energy used to power refineries or generate electricity, or the amount of energy "lost" during fuel processing, distribution, etc. For example, although the data clearly indicate that transportation is the largest consumer of net energy, relative values for the sectors may be affected if we had included energy used for generation, distribution, and other losses.

Second, it is not clear that TBtu is the best unit to make these kinds of comparisons. Although NYSERDA (13) and the US Energy Information Administration (26) use TBtu as a means of comparing different kinds of energy, it may have been preferable to conduct the analysis in terms of GHG emissions as a more meaningful interpretation of potential impact to the environment. Although most energy used in the Town of Smithtown comes from fossil fuels, distinguishing among energy types by GHG emissions might result in changes to the patterns in the data.

Third, it also proved surprisingly difficult to obtain data defined by the geographical area being studied. Some data were at the right scale, but in poor units (such as ZIP Codes). Making incongruent areas fit the study area resulted in losses of accuracy. Other important data were only available on larger scales, and the estimations that resulted from scaling down to the Town also harmed overall accuracy. Each level of remove from Smithtown made the resulting data less likely to be a good fit to the actual situation.

Findings

The transportation sector consumes the largest amount of energy, accounting for over 45% of total net consumption. The commercial and industrial sector consumes approximately one-fifth more energy than the residential sector. Gasoline accounts for approximately one-third of all energy use in the Town. Clearly, there appears to be room to make substantial energy savings by addressing gasoline consumption.

The average fuel efficiency of passenger vehicles was found to be 22.5 mpg. Each increase of 1 mpg would save nearly 3 million gallons of gasoline (0.4 TBtu) in Smithtown. The Town has no authority to regulate automobile efficiency. However, the federal government does, and passed the Energy Independence and Security Act of 2007. This requires fleet averages of 35

mpg by 2020 (including effects from electric, hybrid, and alternative fuel vehicles). Assuming it takes 10-15 years for most of the older vehicles to be retired from use, by around 2030 gasoline consumption in the Town should be approximately 40% less, resulting in an overall decrease in energy consumption and mileage driven. However, there is the potential for local action. By making the Town more walkable, the Town may be able to reduce the number of miles driven by residents. The Town is currently drafting the Transportation Study of its Comprehensive Plan Update, which will address some of the potential methods to reduce the demand for motor vehicle transportation. These include establishing policies that encourage pedestrian traffic over motor vehicle use in the business districts, promoting carpooling, and supporting commuting by public transportation. If policies adopted by the Town reduced motor vehicle travel by 10 miles per vehicle per week, it would be the same as improving fuel efficiency by 1 mpg, and save approximately three million gallons of gasoline (0.4 TBtu). Reducing vehicle miles may be difficult to do because the Town is largely developed, and therefore travel patterns and habits are well-established.

In both the commercial and industrial sector and the residential sector, two-thirds of energy is used for space heating. This implies that adoption of initiatives to facilitate or encourage retrofits targeting heating, such as improving insulation, installing programmable thermostats, and upgrading boilers and other hardware would be effective in improving overall energy use. Sanchez et al. (17) identified equipment upgrades and programmable thermostats as about equally effective, but the methods they used do not translate to estimates for potential savings in Smithtown. The Town is a member of the Long Island Green Homes and Buildings Consortium, which is working to develop financing for energy efficiency retrofits to single-family homes. It would seem reasonable to investigate the potential of expanding this innovative

financing method. As pioneered by the Town of Babylon on Long Island, the governmental unit brokers and guarantees a loan from a commercial bank to be used for upgrades; the loan payment is then rolled into the local tax payment, which provides the lender with assurances that the loan will be repaid, whether there is a mortgage default or resale of the house, because the tax payments are (almost) always collected (eventually). The legality of this approach is currently under review, however.

A few large commercial accounts use a great deal of the natural gas provided to the Town. Improving energy consumption for space heating by 10% in these buildings would have the same impact as eliminating energy consumption for space heating entirely in 3,400 dwellings heated with natural gas. As such, it would seem to be more cost effective to retrofit a small number of large commercial buildings than to retrofit many residential buildings. It might be possible to foster such changes by adapting the Town of Babylon tax payment financing method to large commercial sites.

Approximately 22% of the energy used in commercial and industrial sector is used as electricity. The commercial and industrial sector uses about 50% more electricity than the residential sector. The single greatest use of commercial and industrial electricity appears to be lighting (approximately 37%, although this is not a locally-derived value). It is simple, quick, and relatively inexpensive to substitute one light bulb for another, in most instances. Thus, large reductions in energy use could be gained by persuading building owners to trade in incandescent bulbs for fluorescent, compact fluorescent, or LED light fixtures wherever possible, which generally reduces electricity use by 75-99%. The local utility offers rebate programs for such changes. In contrast, the greatest use of electricity in the residential sector is for appliances (especially refrigerators). Appliances have long life spans and are expensive, so persuading many

homeowners to replace them over short time scales may be difficult. The reduction in energy consumption associated with appliance replacement may be as much as 50%, but that is still a smaller percentage decrease applied to a smaller pool of electricity use, as compared to changes in commercial-industrial lighting. In addition, an unfortunate rule of thumb is that old refrigerators become second refrigerators in a household, or find other reuses (15), and reductions in electricity use from appliance replacement may be substantially smaller than anticipated. Therefore, it would seem that emphasizing lighting upgrades in the commercial sector would have greater benefits and be simpler to implement, all else being equal.

Summary and Conclusions

We identified and quantified the major uses of energy in a suburban New York town using easily accessed data sets. Although there were some methodological issues with this compilation, we believe it is accurate enough to support general analyses that have utility to create broad policy determinations. The greatest single use of energy (45%) in Smithtown was gasoline for transportation. Space heating was also an important use of energy, and a few large commercial-industrial accounts use a great deal of the natural gas sold in the Town. For electricity, commercial and industrial lighting and residential appliances are major consumers.

Many of these areas require no changes in Town policies or codes to address the potential reductions. Gasoline reductions are likely to occur due to the implementation of upgraded federal fleet standards. Town planning can aim to increase the walkability of this highly dispersed suburban community, but the impact of that kind of action is likely to be small, and not realized immediately. The Town is working to create an affordable means of easily obtaining loans for energy efficiency upgrades for residential housing, and should explore the possibility of expanding that program to the commercial and industrial sector. Lighting upgrades in

commercial buildings clearly should be fostered, mostly through an existing utility program. Programs that encourage home appliance upgrades have wide acceptance, but do not appear to be a major priority to achieve energy reductions in Smithtown.

It is easier to adopt policies and induce changes when a clear focus is maintained. It seems that it would be best for the Town to place great effort into implementing and expanding its building efficiency upgrade financing program. The authority of the Town should also be used to educate the public on the benefits of driving more fuel efficient vehicles, changing light bulbs (especially as part of a program targeted at commercial landlords), and, since it is so widely espoused, upgrading to Energy Star-level appliances when possible. This provides the most efficient and seemingly effective use of limited Town resources, while potentially affecting energy use across the Town to make Smithtown more sustainable.

In summary, based on the results of this assessment, the Town of Smithtown and similar municipalities could reduce net energy consumption most significantly by reducing gasoline consumption in motor vehicles by reducing the demand for personal motor vehicle transportation. However, other significant reductions could be attained by installing effective insulation and temperature control systems in a small number of large commercial and industrial buildings. Smaller reductions could be achieved by reducing electricity consumption for lighting and air conditioning in commercial buildings and appliances and air conditioning in residences.

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(28) K. Zickfeld, M.G. Morgan, D.J. Frame, and D.W. Keith, "Expert judgements about transient climate response to alternative future trajectories of radiative forcing," *Proceedings of the*

National Academy of Science (Accepted) (available on-line before publishing)

doi/10.1073/pnas.0908906107

Tables

Zip Code	Post Office	Hamlet in Town of Smithtown	Municipalities that share zip code with Town of Smithtown
11725	Commack	Commack	Town of Huntington
11754	Kings Park	Kings Park	
11767	Nesconset	Nesconset	
11768	Northport	Fort Salonga	Town of Huntington
11780	Saint James	Saint James	Village of Nissequogue, Village of Head-of-the-Harbor
11787	Smithtown	Smithtown	Village of the Branch
11788	Hauppauge	Hauppauge	Town of Islip

Table 1. Zip Codes in greater Smithtown area; 11768 was not included in the analysis

Energy Type	Standard of Measurement	Conversion Factor
Natural Gas	Therm	1 therm = 100,000 Btu
Heating Oil & Diesel	Gallon	1 gallon = 138,691 Btu
Electricity	kWh	1 kWh = 3,412 Btu
Gasoline	Gallon	1 gallon = 124,262 Btu

Table 2. Btu conversion factors

Type	Accounts	Therms	TBtu	Therms per account
Space Heating	18,733	21,748,593	2.17	1,161
Hot Water	723	305,283	0.03	422
Cooking/Drying	1,362	151,402	0.02	111
Total	*20,818*	*22,205,278*	*2.22*	

Table 3. Gas Use by Account Type (10)

		11725	11754	11767	11780	11787	11788	*Total*
Census (22)	# Occupied Housing Units	9,471	6,333	4,504	5,130	11,593	5,776	*42,807*
	# units with natural gas heat	6,047	2,001	823	921	3,263	2,876	*15,931*
	% occupied with natural gas heat	64%	32%	18%	18%	28%	50%	
National Grid (10)	Non Heat (Cooking/Drying) accounts	443	420	27	116	228	128	*1,362*
	Non Heat (Hot Water) accounts	199	207	26	90	137	64	*723*
	Space Heating accounts	6,735	2,438	1,159	1,296	4,121	2,984	*18,733*

Table 4. Residences with natural gas service

		11725	11754	11767	11780	11787	11788	*Total*
Census (22)	# Occupied Housing Units	9,471	6,333	4,504	5,130	11,593	5,776	*42,807*
	# Units with oil heat	2,938	3,875	3,451	3,396	7,453	2,621	*23,734*
	% that have oil heat	31%	61%	77%	66%	64%	45%	*55%*

Table 5. Residences with oil heat

Energy Source	Units	TBtus	Percent
Gas	22,205,278 therms	2.22	34%
Oil	22,516,797 gals.	3.13	47%
Electricity	373,487,085 kWh	1.27	19%
Total		6.62	

Table 6. Energy use in the residential sector

	Gas provided year-round				Dual fuel facilities			
	Hot Water	Space Heating	General Use	Percent	Switch to alternate fuel when contacted	Percent	Automatic switch to alternate fuel	Percent
Therms x 1000	154	13,371	4,988	80.9	1,609	7.0	2,765	12.1
Accounts	19	2,850	508	98.1	29	0.8	35	1.0
Therms x 1000 per account	8.2	4.7	9.8		55.5		79.0	

Table 7. Natural Gas Distribution to Commercial and Industrial Facilities (10)

Energy Source	Units	TBtus	Percent
Gas	22,890,131 therms	2.29	29%
Oil	27,011,280 gals.	3.75	47%
Electricity	560,000,000 kWh	1.91	24%
Total		7.95	

Table 8. Energy Use in the Commercial and Industrial Sector

Energy Use	Units	TBtus	Percent
Non-commercial Vehicles	80,300,000 gals (66,000,000 gals.)	9.98 (8.21)	82 (75)
Commercial Vehicles	15,500,000 gals (20,000,000 gals)	2.15 (2.77)	18 (25)
Street Lights	7,453,200 kWh	0.03	0 (0)
Total		12.16 (11.01)	

Table 9. Energy Use in the Transportation Sector (showing the vehicle type-mileage calculation as an alternative)

	Fuel type (TBtu)				*Total*	*Percent*
Sector	Natural Gas	Heating Oil	Electricity	Gasoline (and diesel)		
Residential	2.22	3.13	1.27		*6.62*	*25*
Commercial/Industrial	2.29	3.75	1.91		*7.95*	*30*
Transportation			0.03	12.13	*12.16*	*46*
Total	*4.51*	*6.88*	*3.21*	*12.13*	*26.63*	
Percent	*17*	*26*	*12*	*46*		

Table 10. Net energy consumption by sector and fuel type (percents have rounding errors)

Figure captions:

Figure 1. Regional map showing location of Town of Smithtown

Figure 2. Town of Smithtown hamlet business centers and commercial highways, and the Hauppauge Industrial Park

Figure 3. Relationships among ZIP Codes, incorporated villages, and unincorporated areas in the Town of Smithtown

Figure 4. Electricity consumption in US housing units (from 26) OA = “other appliances” AC = “air conditioning” R = “refrigerator” SH = “space heating” WH = “water heating” L = “lighting”

Figure 5. Electricity consumption by end use in commercial buildings (from 26) L = “lighting” V = “ventilation” Co = “cooling” R = “refrigeration O = “other” Cp = “computers” SH = “space heating” WH = “water heating” OE = “office equipment” Ck = “cooking”


CONNECTICUT
NEW YORK
NEW JERSEY
TOWN OF
SMITHTOWN
LONG ISLAND
NEW YORK CITY

Figure 1.

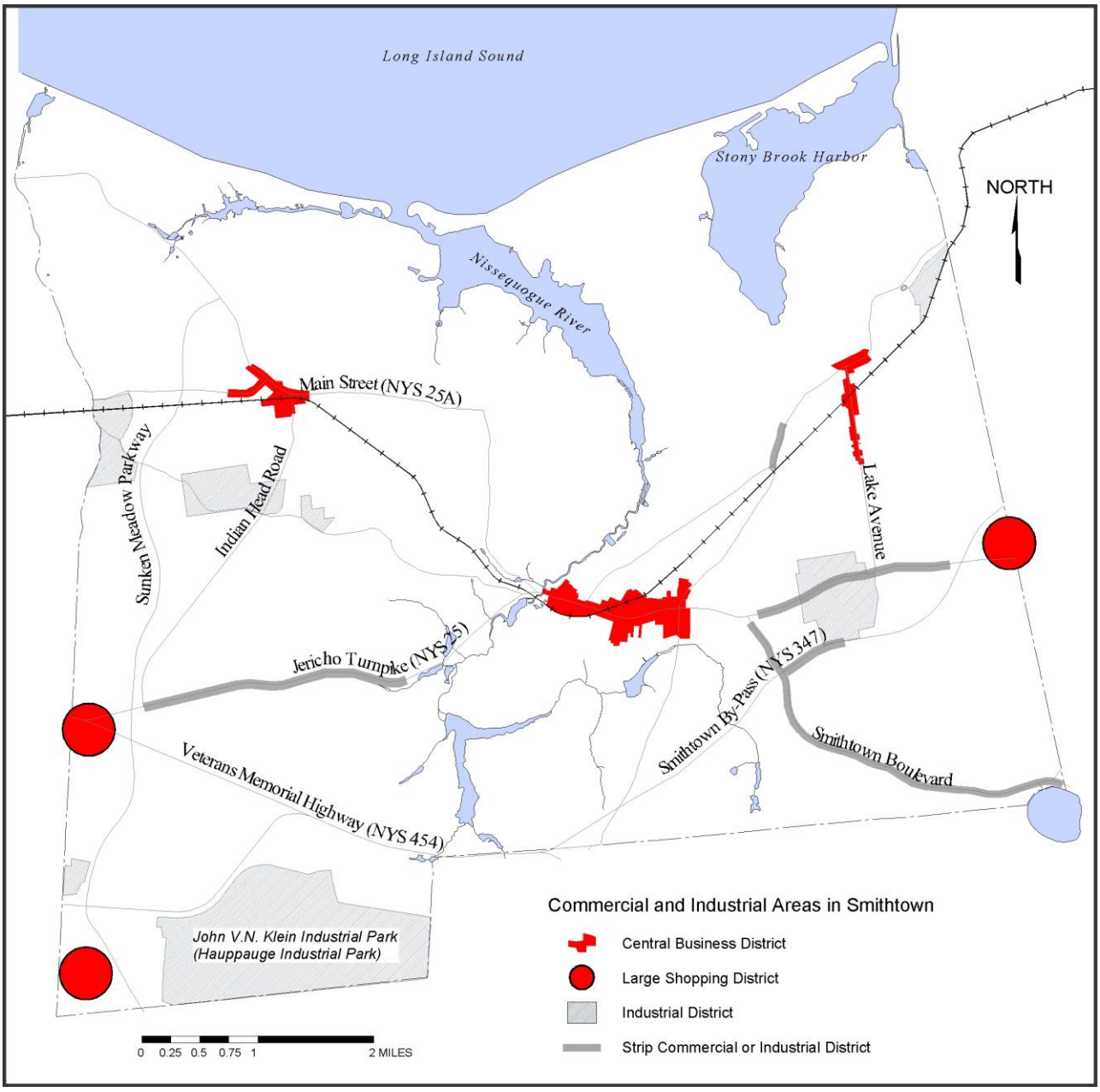
Long Island Sound
Stony Brook Harbor
NORTH
Nissequogue River
Main Street (NYS 25A)
Sunken Meadow Parkway
Indian Head Road
Lake Avenue
Jericho Turnpike (NYS 25)
Smithtown By-Pass (NYS 347)
Smithtown Boulevard
Veterans Memorial Highway (NYS 454)
John V.N. Klein Industrial Park
(Hauppauge Industrial Park)
0 0.25 0.5 0.75 1 2 MILES
Commercial and Industrial Areas in Smithtown
Central Business District
Large Shopping District
Industrial District
Strip Commercial or Industrial District

Figure 2.

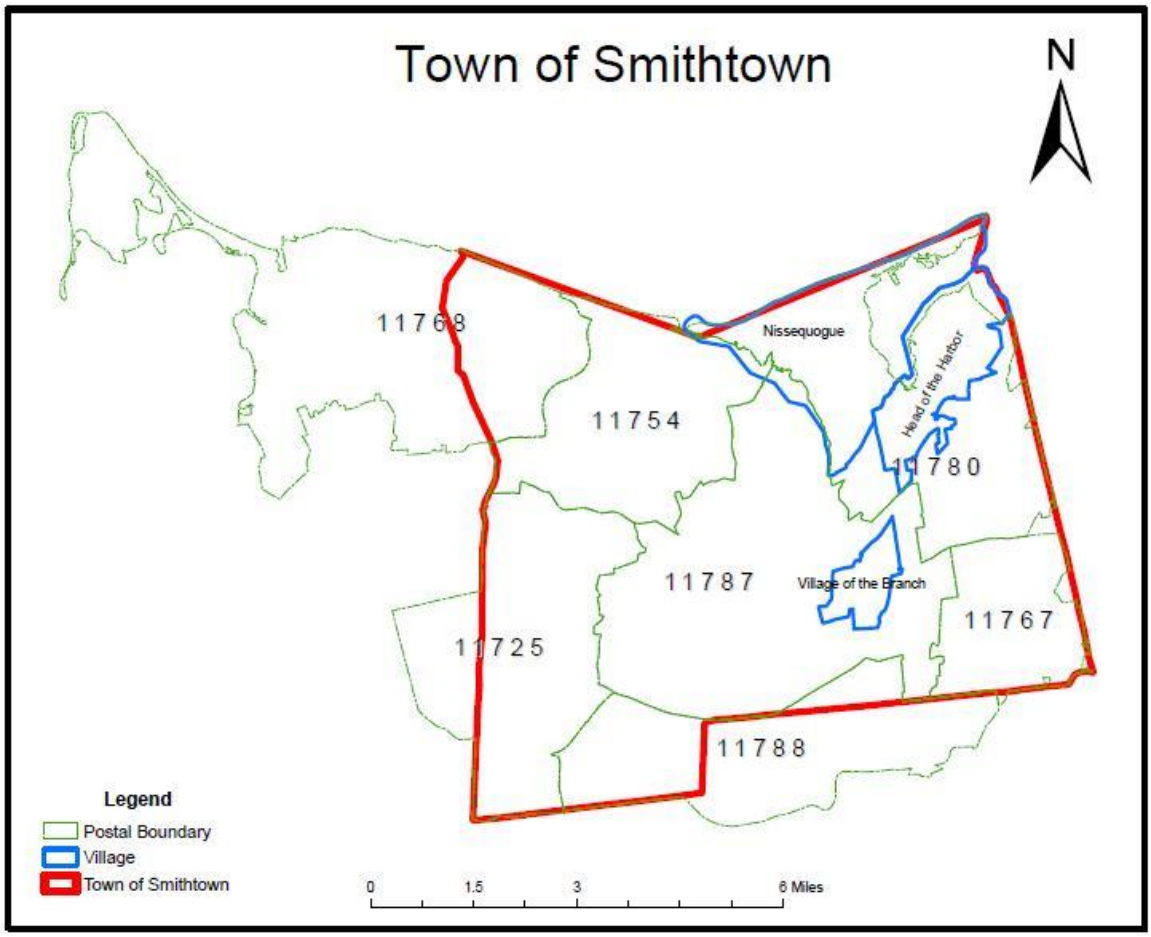
Town of Smithtown
N
11768
11754
Nissequogue
Head of the Harbor
11780
11787
Village of the Branch
11767
11725
11788
Legend
Postal Boundary
Village
Town of Smithtown
0
1.5
3
6 Miles

Figure 3.

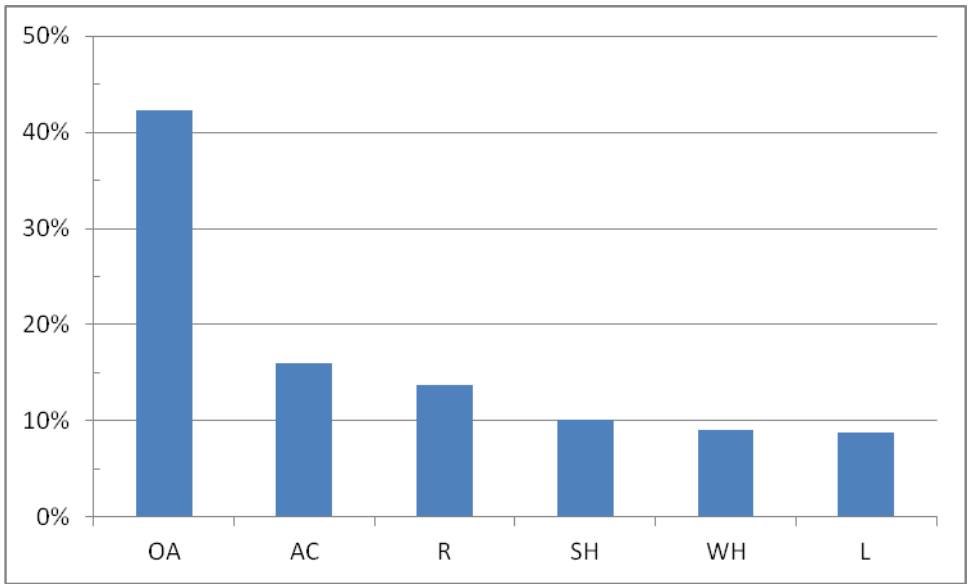

Figure 4.

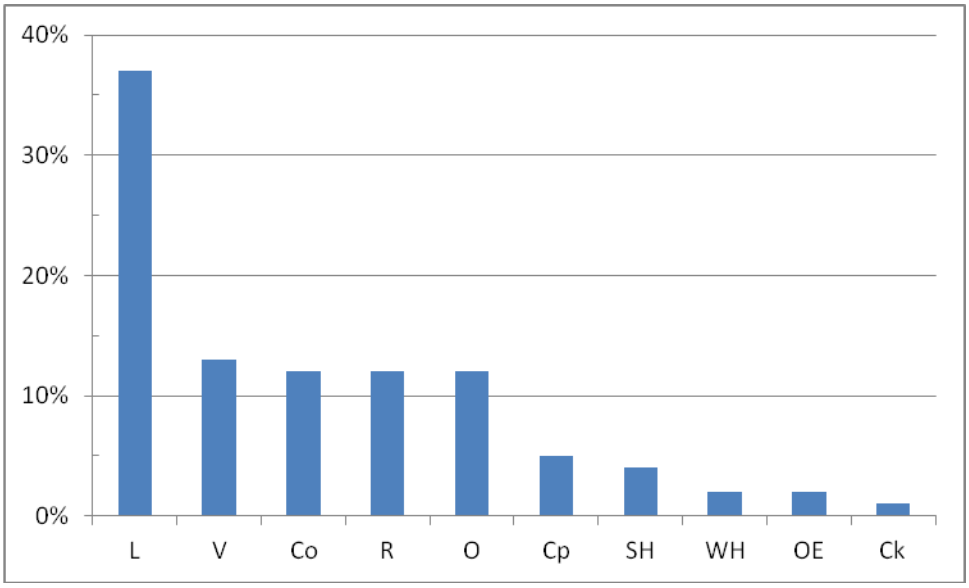

Figure 5.